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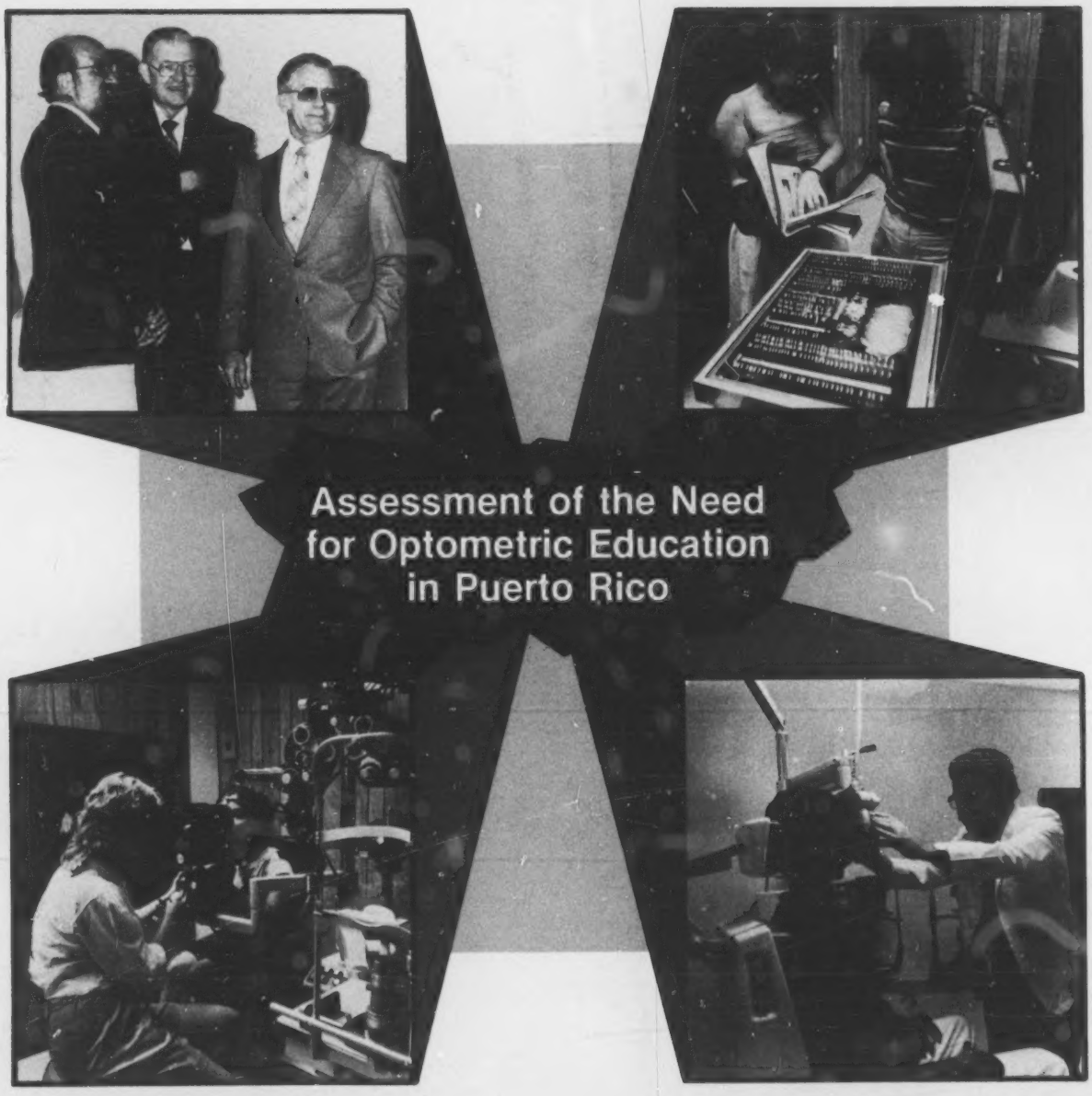

Assessment of the Need for Optometric Education in Puerto Rico

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Edwin C. Marshall, O.D., M.S., M.P.H.

Establishment of a new school of optometry at Inter American University of Puerto Rico will serve an unmet need for optometric services on the Island of Puerto Rico, but also needs to address a potential saturation of optometrists by the year 2000 (a three-part article).

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Cover: Participating in the dedication ceremony (upper left photo) of the Inter American University of Puerto Rico, School of Optometry in January, 1981, are (l-r) Dr. Jorge Gorbea, former president of the Puerto Rican Optometric Association, Dr. Henry W. Hofstetter, former acting dean of the school, and Lee W. Smith, M.P.H., executive director of the Association of Schools and Colleges of Optometry. The other photos depict recent scenes photographed at the school. Our thanks is extended to Dr. Arthur J. Afanador, dean, and Jesus R. Paris, administrative assistant, of the IAU School of Optometry for their assistance in providing the photographs for this issue.

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Assessment of the Need for Optometric Education in Puerto Rico

Edwin C. Marshall, O.D., M.S., M.P.H.

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Demographic, Socioeconomic and Health Characteristics

The establishment of a new school of optometry in the Commonwealth of Puerto Rico has necessitated the development of a plan for the didactic and clinical education of its students and for the rendering of patient care services to the island population. Based upon an assessment of the need for optometric services at the present and in the future, a model for the development and implementation of a clinical program must be constructed, considering both the needs of the institution and of society.

Introduction and Background

A study of the availability of optometric manpower and the demand for vision care services was conducted for the Island of Puerto Rico and reported in a 1979 document, titled "Inter American University of Puerto Rico: Plans to Establish a School of Optometry."[1] The results of the study identified a tremendous unmet need for services, resulting primarily from a critical shortage of optometrists on the island. To respond to this need and to initiate a strategy for alleviating the shortage of practitioners, the study recommended the establishment of a school of optometry in Puerto Rico.

As a result of the coordinated effort among the Colegio de Optometras de Puerto Rico, the American Optometric Association, the Association of Schools and Colleges of Optometry, and Inter American University of Puerto Rico, leading to the recommendation for and the subsequent establishment of the first school of optometry on the Island of Puerto Rico at Inter American University in San Juan, the Inter American University (IAU) School of Optometry matriculated its first class of twenty-seven students during the 1980-81 academic year to become Puerto Rico's first and only professional degree program for the education and training of optometrists.

The previous study indicated that there is a severe shortage of optometric manpower on the island and that a sizeable portion of the population and its vision care needs are either underserved or unserved.[1] However, the impact of the School of Optometry, including the impact of its clinical delivery system and the continuous production of optometric manpower, must be documented further, particularly in light of plans to establish an extensive vision care delivery system and training program which would provide optometric care to geographical areas within and, especially, outside of the immediate San Juan metropolitan area. Therefore, a study on "The Status of Optometric Manpower and the Development of Clinical Education in Puerto Rico" was undertaken and completed in 1982[2] in an attempt to provide data for the school administration in its efforts to design a clinical curriculum and implement a vision care delivery system that

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FIGURE I-1
Health Regions of Puerto Rico
(Puerto Rico Department of Health State Health Plan, 1980-1985, p II-3)

Edwin C. Marshall, O.D., M.S., M.P.H., is associate professor of optometry and chairman of the Department of Clinical Services at Indiana University, School of Optometry, Bloomington. Dr. Marshall served as a consultant for clinical development of the School of Optometry at Inter American University of Puerto Rico, Hato Rey, in 1982. This paper presents the results of a study he performed in conjunction with his M.P.H. thesis through the University of North Carolina, Chapel Hill, School of Public Health, Department of Health Administration.

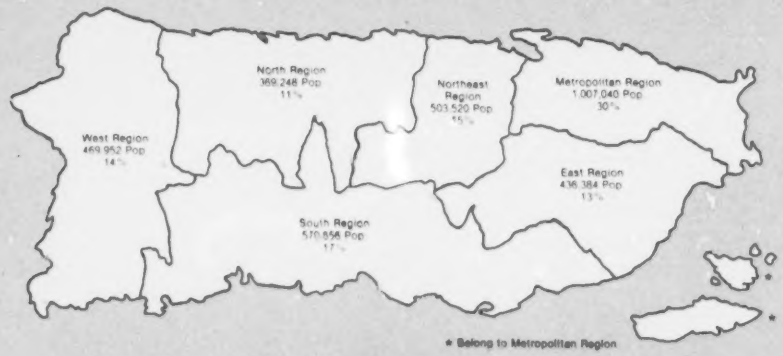

FIGURE I-2
Population Estimates and Percentage Distribution by Health Region, Puerto Rico, 1978

(Puerto Rico Planning Board, Economic Report to the Governor, Puerto Rico, 1978; Puerto Rico Department of Health State Health Plan, 1980-1985, p II-10)

would be most efficacious to the goals and objectives of the school and the needs of the Puerto Rican population.

Some of the results of the 1982 study will be presented as part of this overall assessment of the need for optometric education in Puerto Rico. Part I will look at the demographic, socioeconomic and health characteristics of the Puerto Rican population; Part II will present the results of the analysis of the present (i.e., 1982) status of vision care manpower in the Commonwealth; and Part III will look at the projected impact of the IAU School of Optometry upon the adequacy of vision care manpower in Puerto Rico up to the year 2000.

Demographic Characteristics

The Island of Puerto Rico is the smallest island in the Greater Antilles, measuring 100 miles by 35 miles. Bordered by the Atlantic Ocean on the north and the Caribbean Sea on the south, Puerto Rico is 75 percent mountainous and maintains a tropical climate with an average yearly temperature range between 73°F and 79°F. The total population, based upon a 1970 censual population of 2.7 million, was estimated by the Puerto Rico Planning Board to be 3.2 million in 1977 and 3.3 million in 1978.[3]

According to the 1977 estimates, 62 percent of the population resides in urban areas with an average population density for the whole island of 981 people per square mile, ranging from 2,499 per square mile in the San Juan Metropolitan Region to 571 per square mile in the North Region. Of the six health regions of Puerto Rico (i.e., Metropolitan, Northeast, North, South, East and West), the San Juan Metropolitan Region has the largest population concentration, totaling slightly over one million for 30 percent of the total island population. Each of the remaining five regions contains between 11 percent and 17 percent of the total populations (Figures I-1 and I-2, Table I-1).

Even though the birth, mortality and natural increase rates have been declining since 1940, the annual growth rate has been increasing (e.g., 2.5 percent between 1975 and 1978) as a result of inward migration. However, population projections to the year 2000 reflect a gradual decrease in the average annual population growth, down to an average annual rate of 0.7 percent for the years between 1995 and 2000.[4] This decrease is reflective of projected decreases in the birth rate, falling from 24.5 live births per 1,000 population in 1970-1975 down to 15.0 live births per 1,000 population in the year 2000.

Over 50 percent of the population is under twenty-five years of age, such that the median age for the entire population is twenty-three years. The zero to fifteen year age group accounts for 34 percent of the total population; the sixty-five and over age group accounts for 7 percent.[5] Together, these two groups constitute an economically dependent population of 41 percent of the total, resulting in a dependency rate of 0.70. Forty-five percent of the female population, or 23 percent of the total population, is in the child-bearing age range of fifteen to forty-four years. The total population is 49 percent male and 51 percent female, giving a male/female ratio of 0.96.

Socioeconomic Characteristics

The unemployment rate, as an indicator of economic dependency, reached a high of 19.7 percent in 1977 and declined slightly to 17.0 percent in 1979.[6] The average family income for 1980 was estimated to be $8,910, varying from a high of $9,389 in the Metropolitan Region to a range of $6,908 to $6,178 for the East, Northeast, South and West regions and to a low of $5,937 for the North Region. The median income in 1980 for the entire island was $7,360, an increase of $1,257 over the 1975 figure of $6,103. With a 4 percent average annual increase in median income, the average cost of living increase between 1975 and 1979 was 4.5 percent, including an average cost of medical care increase of 7.5 percent. Twenty-nine percent of the housing in the rural areas and 18 percent of the urban housing were considered to be inadequate in 1977. The illiteracy rate for the total population in 1976 was 8.7 percent, with an urban-rural distribution of 6.3 percent and 12.1 percent, respectively. In 1975, 62 percent of the population fell below the official poverty line of the federal government.[6]

According to the Department of Health, "[e]mployment, income, education, and welfare are prime influences or even determinants in the physical and mental health status of the population. . . . Puerto Rico's population growth . . . has contributed to an imbalance between population and production resources," and "[t]he population level has exceeded one that cannot be adequately attended to, thus compounding a series of social and economic problems. . ."[7]

In a discussion of the health care system in relation to the medically indigent, the Department of Health made the following comments:

> The health system in Puerto Rico consists of a public sector providing community health services to all the population and personal health services to the medically indigent, and a private medical practice directed at a paying clientele. The supply of public services cannot meet the demand, and private services are beset by steadily rising costs. The increase in the costs of medical services and of health insurance coverage limits the private providers' access for a high percentage of the people of Puerto Rico.

TABLE I-1.

Population Profile for the Six Health Regions, Puerto Rico, 1978

Health Region/ Puerto Rico	Estimated Population[1]	Percent of Total	Population Density Per Square Mile[1]
Metropolitan	1,007,040	30.0	2,499
Northeast	503,520	15.0	1,459
North	369,248	11.0	571
South	570,656	17.0	698
East	436,384	13.0	842
West	469,952	14.0	681
Puerto Rico	3,356,800	100.00	981

[1]Based on estimates of the Puerto Rico Planning Board, Economic Report to the Governor, Puerto Rico, 1978, reported in Table II-3 and Table II-4 of the Puerto Rico Department of Health State Health Plan, 1980-1985.

Thus, the medically indigent are those persons and/or families that the Department of Social Services determines are economically dependent, or 70% of the population in 1978. . . . These figures reflect the level of medical indigency, as there is a direct relation between economic dependency and the level of indigency of the population.[8]

Health Characteristics

Generally, the health status of the Puerto Rican population is such that the life expectancy at birth has exceeded that of the United States. As of 1976, the life expectancies for Puerto Rico and the United States were 73.5 and 72.8 years, respectively—77.1 and 77.3 years for females and 70.2 and 69.7 years for males.[9] The mortality rate for Puerto Rico has dropped to 6.0 per 1,000 in 1977 from a rate that exceeded 30 per 1,000 in 1900.[10] The infant mortality rate in 1977 was 20.1 deaths per 1,000 live births; a rate which is considerably less than the 1900 rate of 200 per 1,000 live births, but which is still 43.5 percent greater than the 1977 rate (i.e., 14.0 per 1,000) of the United States.[11] Similarly, maternal mortality has decreased from a rate of 47.2 per 10,000 live births in 1940 to 1.3 per 10,000 in 1977.[12]

Among the other indicators of health status used by the Department of Health to describe the health of the Puerto Rican population, the "Potential Years of Life Lost (PYLL)" has been used to investigate the impact of premature death upon the years of life lost in a population.* Using the PYLL to rank the leading causes of death in Puerto Rico, 1977 data indicate that accidents (while responsible for only 4.9 percent of all recorded deaths) represented 23.3 percent of the PYLL by the ten leading causes of death.[13] Following accidents, heart diseases, cancer, homicides, cirrhosis, suicides, pneumonia, cerebrovascular diseases, diabetes mellitus, and arteriosclerosis completed the list, in descending order of PYLL, of the ten leading causes of death in Puerto Rico.

$$*\text{PYLL} = \sum_{i=1}^{69} a_i d_i$$

where, d_i = the number of deaths between ages i and i + 1; and

a_i = the remaining years to live until age 70 when death occurs between ages i and i + 1.

Health Care in Puerto Rico

The Island of Puerto Rico is divided into six health regions, and each region is further subdivided into two or three areas which are served by area hospitals. Each area consists of three to seven municipalities, each with its own primary care health center. Basic services, involving diagnosis, treatment and prevention, are provided by Family Health Teams which are composed of family physicians, some specialists, and specially trained allied personnel. In describing the entry into the health sys-

Dr. Henry W. Hofstetter (upper right) served as acting dean of the new IAU School of Optometry from January to May, 1981. Below, the first class of twenty-seven students was matriculated during the 1980-81 academic year.

tem, the Department of Health stated the following: "Patients are referred from the local level (municipal) to an intermediate level (area) hospital or to regional hospitals, and from there, if the medical condition so requires, to one of the three modern medical centers located in the Northeast, South and West regions of the Island."[14] Between the public and private health care sectors, it is estimated that the public sector is responsible for 60.1 percent of the population and the private sector serves approximately one-third of the population.[15]

According to the Department of Health, Puerto Rico does have a problem providing and maintaining an adequate distribution of health professionals, especially in the rural areas, the small towns, and in the interior mountain zone of the island:

"Puerto Rico does have a problem providing and maintaining an adequate distribution of health professionals, especially in the rural areas, the small towns, and in the interior mountain zone of the island . . ."

Puerto Rico has had problems in bringing about an equitable distribution of health manpower. Most health workers are concentrated in the metropolitan areas, and in towns rather than in rural areas. Faced with these geographical disparities, in 1978 the Department of Health proposed legislation requiring all students graduating from the health professions to provide services in the public sector for one year. Because this was made a prerequisite to licensure in over fifteen health-related professions, the enacted measure was in effect a compulsory health 'draft' enabling the Health Department to deploy recent graduates to underserved areas . . . This step was justified on two grounds:

1. the proven inability of market forces to match resources, and
2. the fact that the education of the overwhelming majority of students is publicly subsidized.

Since its introduction, the legislation has achieved its aim of bringing about a better distribution of health manpower . . . every local jurisdiction has at least one doctor providing primary care.[16]

Reliable and comprehensive epidemiological data on the incidence and prevalence of visual disorders in the Puerto Rican population have not been readily available or retrievable through previous surveys or health department records. Such a lack of available data is indicative of the severity of the problem and task of planning for an effective and efficient system of vision care service delivery. It is not reflective of a lack of an epidemiological need for an expanded vision care system, but it is suggestive of the need to implement an effective data management system for the periodic collection and analysis of visually-related epidemiological data.

As a result of a collaborative effort to provide information on vision care practitioners and data on the prevalence of visual conditions in Puerto Rico, and utilizing the resources of the Division of Associated Health Professions (Health Resources Administration, U.S. Department of Health and Human Services [DHHS]), the Office of the Cooperative Health Statistics System (Health Services and Facilities Administration of the Puerto Rico Department of Health), and the data obtained from the Puerto Rico Household Interview Survey, the recently published report on *Vision Care In Puerto Rico, 1980-81* has attempted to provide some of the needed information on the status of vision care in the Commonwealth of Puerto Rico.[17] Based upon the data of the Health Interview Survey, the "sample population reported a total of 330 visual conditions for a rate of 636.1 visual conditions per 10,000 persons per year."[18] Of the 330 visual conditions, 115 were classified as visual diseases with a rate of 221.7 per 10,000 population per year; and 215 were classified as visual defects or impairments, with a rate of 414.4 per 10,000 population per year. As with many epidemiological profiles, the incidence and prevalence of visual disorders generally correlate well with the age and socioeconomic status of the population. "Of the number of persons reporting visual conditions, two percent were under six years of age as compared to 63 percent who reported being over 44 years of age. . . . Of the total number of persons reporting one or more visual conditions, 62 percent had less than 7 years of schooling with 38 percent reporting 7+ years of school completed."[19]

The 1980 report of the Office of Technology Assessment has indicated a relationship between the prevalence of "vision impairment" and family income in the United States, demonstrating a prevalence rate of 114.1 per 1,000 persons between the age of forty-five to sixty-four with incomes under $5,000 in comparison to rates of less than one-half this rate for persons with higher incomes.[20] The high economic dependency rate of 0.70 for the Puerto Rican population serves as a major indicator of the degree of medical indigency that exists on the island, including the degree of unmet need for vision services. □

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PART II

Vision Care Needs and Manpower

Part II of the "Assessment of the Need for Optometric Education in Puerto Rico" will focus upon the methodologies employed and the conclusions generated in the analysis and assessment of optometric manpower and the distribution of vision care services in the Commonwealth of Puerto Rico, with the following goals and objectives:

1. To evaluate the epidemiological need and effective demand for optometric services in accordance with existing data and previously documented goals for visual health;

2. To evaluate the supply and productivity of the existing vision care manpower through the application of the current U.S. Public Health Service vision care shortage area criteria; and,

3. To evaluate the existence and the extent of any unmet need for optometric services.[1]

Assessment of "Need" in Relation to "Demand" and "Requirements"

The terms associated with manpower analysis—need, demand, and requirements—are used often in discussions of health manpower without a full understanding of their respective meanings and appropriate usage. For the purpose of this study, the following definitions of need, demand, and requirements have been adopted:

Need—an estimation based on professional judgment and current medical technology of the number of workers or amount of services necessary to provide an optimum standard of health care;

Demand—the sum of the amounts of the various types of health services that the population of a given area will seek and has the means to purchase at the prevailing prices within a given time period; and,

Requirements—the amount of services, manpower, etc. required to satisfy a given set of assumptions about how the health sector does, could, or should function.[2]

The concept of need relates more to an epidemiological assessment of the number and type of health professionals required to attain and/or maintain an optimum level of health care within a given area; whereas, demand tends to be more reflective of economic trends and consumer behavior. The determination of the appropriate requirement levels for health manpower, therefore, must be conditioned upon a judgment that relates to a preception which falls within the parameters of need and demand.

In consideration of the factors associated with the need for health care versus the demand for health care, several methods have been employed by different researchers to assess the adequacy of health manpower and to project requirements for the future. Some of the more traditional methods that have been used are: the manpower/population ratio and utilization mode; trend analysis and the trend model; the medical (health, biological) need based ratio, the professional judgment based ratio; the demand/productivity based ratio; the economic (effective) demand approach; the health maintenance organization (HMO) based ratio; and the international comparison approach.[3,4,5,6,7,8]

Following an analysis of the strengths and weaknesses of what it considered to be the two most relevant methods—the need based model and the demand based model—the Graduate Medical Education National Advisory Committee adopted an "adjusted need based" approach in determining the physician requirements for 1990 and 2000.[9] In its *Third Report to the President and Congress on the Status of Heaith Professions Personnel in the United States*, the U.S. Department of Health and Human Services used the "adjusted utilization" approach to estimate the number of health professionals required to satisfy the level of health care utilization that most likely would be demanded by consumers in the future.[10] In addition to the adjusted need and the adjusted utilization approaches, econometric models which use mathematical formulae to generate the quantities of services that would be demanded and supplied at various prices are being used more and more to project future manpower requirements.

Supply and Productivity

In the United States, it has been determined that the optimum supply of optometric manpower can be estimated from an application of the optimum optometric manpower requirement ratio of one optometrist per every 7,000 people, or 14.3 optometrists per 100,000 population.[11,12,13] The range of requirement ratios provided by the U.S. Department of Health, Education, and Welfare (DHEW) in its 1976 publication, *Review of Health Manpower Population Requirements Standards*, support the use of the one to 7,000 ratio for optometric manpower, as determined by its reporting of the requirements under the professional judgment and the demand/productivity based ratios.[7,14] The DHEW estimate under the need based ratio increased the requirement to 24.2 optometrists per 100,000 population, or one optometrist for every 4,132 people. From an analysis of 1975 data, it was reported that the actual ratio of active optometrists per 100,000 population was 9.3;[14] and that this rate has remained relatively constant over a ten-year period.[15]

"The annual productivity of optometric practitioners is dependent upon many factors, including the type and number of services provided and the utilization of ancillary personnel."

The estimation of the optimum supply of optometrists required to meet the populational demand is based upon the projected utilizational demand for services by the consumer and the productivity of the optometrist in providing the services. Irrespective of the prevailing economic demand for vision care, the American Optometric Association (AOA) has recommended an annual visit frequency or utilization rate of between 0.50 and 1.00 as the appropriate intervals between optometric examinations for "problem free" patients.[16] The AOA recommended rates are reported as age-specific rates (i.e., 0.50 for the 25-44 age group; 0.67 for the 17-24 and the 45-54 age groups; and 1.00 for the 0-4, 5-16, 55-64, and over 65 age groups) which allow them to be applied to any given population with a known age distribution. The recommended intervals between examinations become shorter with the onset of visual problems and/or complaints (e.g., refractive, binocular, performance, organic).

The annual productivity of optometric practitioners is dependent upon many factors, including the type and number of services provided and the utilization of ancillary personnel. Using the number of vision examinations that can be performed annually as the index of productivity, several recent studies have reported average annual optometric productivity figures of 1,350 visits, 1,526 visits and 1,690 visits per year.[15,16,17] The use of auxiliaries has been reported to increase the productivity of the average optometrist by nearly 20 percent.[15] Within a mean of 69.4 total patient visits per week, a mean of 35.1 refractive analyses per week has been reported as another index of optometric productivity.[18]

Methodology

The methodological approach of this study incorporated the use of certain guidelines that already have been established from previous studies as a proxy for targeted levels of need, demand, supply and productivity. The application of these guidelines, however, should be couched within the caveat that the market imperfections of the health industry, which work to undermine the principles of the classical economic theory of supply and demand, may be different in Puerto Rico from those of the mainland United States, upon which the guidelines are based. Unfortunately, the lack of more definitive data for the Puerto Rican population necessitates the utilization of the mainland U.S. statistics.

The U.S. Public Health Service

(PHS) has reported a series of age-specific utilization rates which it uses to determine the number of optometric visits required per year by a given population in the designation of vision care shortage areas.[19] These rates are much more conservative than those recommended by the AOA, as discussed earlier. They tend to be more reflective of the effective demand for optometric services, relative to an adjusted epidemiological need according to the age distribution within the population. As a proxy for the evaluation of the epidemiological need, demand and requirements for optometric services within the Commonwealth of Puerto Rico, the following PHS utilization (i.e., effective demand) rates were applied to the Puerto Rican population:

Age	Annual Utilization Rate[19]
Under 20	0.11
20-29	0.20
30-39	0.24
40-49	0.35
50-64	0.41
65 and Over	0.48

Even though the utilization rates are based on empirical data, it should not be implied that they are indicative of the optimum situation with respect to the utilization of vision care services. People do not always demand what they need; they may demand less services even though the epidemiological need may be greater. The utilization rates may be more indicative of the prevailing socioeconomic trends within the area and, therefore, may be inaccurate in the assessment and projection of the true need for optometric services. They have been selected, however, for use in this study because of their "low end" projections of consumer demand for vision care services.

The evaluation of the supply and productivity of the existing vision care manpower in Puerto Rico was conducted through the application of similar U.S. Public Health Service vision care shortage area criteria to the available data. According to the PHS criteria, a ratio of one optometrist per 15,000 population (or 6.7 optometrists per 100,000 population) is considered to be adequate in meeting the populational demand for vision care within a given area.[19] Based upon an average optometric visit frequency rate (i.e., utilization rate or effective demand) of 0.20 per year for all ages, the U.S. Public Health Service has determined that the output or productivity of an "average" optometrist would permit him or her to respond to a demand of 3,000 visits per year (i.e., 15,000 x 0.20), assuming that the average annual visit frequency rate is, in fact, 0.20 for any given population.

The evaluation of the existence and the extent of any unmet need (i.e., effective demand) for vision care services within Puerto Rico was based also upon PHS criteria.[19] Puerto Rico will be considered to have a significant optometric visit shortage if the shortage is equal to or greater than 1,500 visits per year (i.e., equal to or greater than the productivity of one-half of one optometrist, based upon an annual productivity of 3,000 visits per optometrist) as determined by the following formula:

$$U_o = R_o - E_o$$

where, U_o = the optometric visit shortage

R_o = the optometric visit requirement

E_o = the optometric visits supplied

such that, R_o = the utilization rate for each age group multiplied by the size of the population of the respective group and summed across all groups

E_o = (3,000 x the number of optometrists under the age of 65) + (2,000 x the number of optometrists age 65 and over) + (1,500 x the number of ophthalmologists)

The above formula includes an adjustment factor for the estimated decrease in productivity of optometrists age 65 and over; and, it incorporates a projected productivity of ophthalmologists in providing vision care services. It, therefore, considers the substitutability of services and the combined effect of optometry and ophthalmology in the provision of vision care.

The results and conclusions of this study are based upon data provided by

TABLE II-1

Effective Demand for Vision Care Services Relative to Age Distribution and Public Health Service Annual Utilization Rates, Puerto Rico

Age	Population[1]	Annual Utilization Rate Per Age[2]	Annual Effective Demand
Under 20	1,491,601	0.11	164,076
20-29	507,375	0.20	101,475
30-39	398,779	0.24	95,707
40-49	306,335	0.35	107,217
50-64	367,298	0.41	150,592
65 and Over	247,612	0.48	118,854
Puerto Rico	3,319,000		737,921

$$\frac{\text{737,921 Optometric Visits Required}}{\text{3,000 Visits Per Optometrist}} = \text{246 Optometrists Required}$$

[1]Based on the population as of July 1, 1977 (Puerto Rico Planning Board, Compendium of Social Statistics, Puerto Rico, 1978, reported in Table II-5 of the Puerto Rico Department of Health State Health Plan, 1980-1985).

[2]US Department of Health, Education, and Welfare (Rules and Regulations, Designation of health manpower shortage areas, 1978).

TABLE II-2

Optometric Manpower by Health Region, Puerto Rico

Health Region	Number of Optometrists[1]	Percent of Total	Per 100,000 Population[2]	Population Per Optometrist
Metropolitan	30	61.2	3.0	33,568
Northeast	5	10.2	1.0	100,704
North	0	0.0	0.0	— —
South	7	14.4	1.2	81,522
East	3	6.1	0.7	145,461
West	4	8.2	0.9	117,488
Puerto Rico	49	100.0	1.5	68,506

[1]Based on 1982 estimates (Colegio de Optometras de Puerto Rico).

[2]Based on 1978 estimated population (Puerto Rico Planning Board, Economic Report to the Governor, Puerto Rico, 1978, reported in Table II-3 of the Puerto Rico Department of Health State Health Plan, 1980-1985).

TABLE II-3

Present Requirements for Optometric Manpower and Range of Deficit by Health Region, Puerto Rico

	Numerical Requirements per Regional Population[1]			
Health Region	@6.7/100,000	@9.3/100,000	@14.3/1000,000	Range of Deficit
Metropolitan	67.5	93.7	144.0	-37.5 to -114.0
Northeast	33.7	46.8	72.0	-28.7 to - 67.0
North	24.7	34.3	52.8	-24.7 to - 52.8
South	38.2	53.1	81.6	-31.2 to - 74.6
East	29.2	40.6	62.4	-26.2 to - 59.4
West	31.5	43.7	67.2	-27.5 to - 63.2
Puerto Rico	224.8	312.2	480.0	-175.8 to -431.0

[1]Based on estimated population for 1978 (Puerto Rico Planning Board, Economic Report to the Governor, Puerto Rico, 1978, reported in Table II-3 of the Puerto Rico Department of Health State Health Plan, 1980-1985).

the Office of Planning, Evaluation and Development of the Puerto Rico Department of Health, the Colegio de Optometras de Puerto Rico, and Inter American University. As discussed in Part I, the Puerto Rico Department of Health has divided the island into six health regions, each of which is subdivided into two or three areas to be served by an area hospital; each area contains three to seven municipalities. The assessment of need for vision care services was conducted for the island as a whole and, where appropriate data were available, for each of the six health regions.

Findings and Discussion on the Status of Vision Care Manpower in Puerto Rico

In determining the annual effective demand for vision care services, data on the age distribution of the population by health region were not available; therefore, only an aggregate computation could be performed. Applying the age-specific annual utilization rates of the U.S. Public Health Service to the 1977 data for the Puerto Rican population, the combined effective demand for all age groups was determined to be 737,931 optometric visits per year as shown in Table II-1. As a result of the size of the population within the given age groups and the weighting of the respective utilization rates, the greatest demand is experienced by the under-twenty-age population, with an annual requirement of 164,076 visits. A requirement of 150,592 visits by the fifty to sixty-four age group provided the second highest demand for vision care; the thirty to thirty-nine age group provides the least demand with 95,707 visits. Under the assumption that a given optometrist can satisfy a requirement of 3,000 visits per year, the annual effective demand for the total island population would necessitate a supply of 246 optometrists.

With a total active manpower force of forty-nine optometrists in 1982, the provider to population ratios for the six health regions are considerably deficient, ranging from a high of 3 per 100,000 in the Metropolitan Region to a low of zero optometrists in the North Region. Table II-2 provides data on the distribution of optometric manpower by region. A sizeable majority of 61.2 percent of the practitioners are found in the Metropolitan Region, with the next highest percentage of 14.3 percent being found in the South Region. For the total island, the provider to population ratio is 1.5 optometrists per 100,000 population, or one optometrist per 68,506 people.

In estimating what the supply of optometric manpower should be for the island and the individual regions, three different requirement ratios were selected to provide the guidelines for making the estimation. The U.S. Public Health Service ratio of 6.7 optometrists per 100,000 population (i.e., one optometrist for 15,000) was selected to represent the low end of the "acceptable range of adequacy," and the Birchard and Elliott ratio of 14.3 per 100,000[11,12,13] was selected for the high end of the acceptable range. The ratio of 9.3 optometrists per 100,000 population, which is the approximate ratio currently found in the United States, is used to represent the middle of the range. Table II-3 provides an analysis of the application of these three ratios to the Puerto Rican population. Even though the Metropolitan Region has the highest percentage of practitioners of any other region (i.e., 61.2 percent), it also has the greatest deficit of practitioners with a deficit range of -37.5 (at a requirement of 6.7 per 100,000) to -114.0 (at a requirement of 14.3 per 100,000). Likewise, the North Region which includes no optometric practitioners has the smallest practitioner deficit, with a range of -24.7 to -52.8. All regions experience a considerable shortage of practitioners, and the whole island shows an average practitioner shortage of between 175.8 and 431.0. The estimated manpower requirements for the total island of between 224.8 and 480.0 practitioners is in agreement with the estimated requirement of 246 practitioners which was derived from the effective demand analysis of the age-specific populations in Table II-1. Due to the lack of appropriate data, the regional computations for the practitioner requirements in Tabie II-3 cannot at this time be age-adjusted to facilitate the inter-regional comparisons.

The evaluation of the existence and the extent of any unmet need or demand for vision care services must take into consideration the contribution of ophthalmological manpower and the declining productivity of older optometrists. There are approximately 110 ophthalmologists in practice on the island; and given the number (i.e., 49) of optometrists, the ratio of ophthalmologists to optometrists in Puerto Rico (i.e., 2:1) is inconsistent with the present thinking in regard to the epidemiological need for the respective services of the two professions.[7,14] A more appropriate ratio would be one ophthalmologist for three to four optometrists (i.e., 1:3 or 1:4).

Of the forty-nine optometrists practicing in Puerto Rico, it is believed that two are over the age of sixty-five. The majority (i.e., twenty-six) are between the ages of fifty and fifty-nine, and only thirteen are below the age of fifty (Table II-4). In applying the formula, $U_o = R_o - E_o$, to assess the shortage of optometric visits as the index of the extent of unmet need, R_o (the optometric visit requirement) is equal to 737,921 visits (i.e., the annual effective demand summed across all age groups). (See Table II-1.) E_o (the optometric visits supplied) can be calculated by multiplying 3,000 (the number of visits that can be adequately handled in one year) by the number of optometrists under the age of sixty-five, added to the product of 2,000 (representing a reduced level of productivity) times the number of optometrists age sixty-five and over, plus the product of 1,500 (representing the equivalent of one-half of one optometrist) times the number of ophthalmologists engaged in active practice. Using the data from

TABLE II-4

Age Distribution of Optometrists, Puerto Rico, 1982

Age	Number of Optometrists[1]
Under 30	1
30-39	9
40-49	3
50-59	26
60-64	8
65 and Over	2
Total	49

[1]Based on 1982 estimates (Colegio de Optometras de Puerto Rico).

Puerto Rico, the following results were obtained:

E_0 = (3,000 x 47) + (2,000 x 2) + (1,500 x 110)

= (141,000) + (4,000) + (165,000)

= 310,000 optometric visits supplied

U_0 = 737,921 visits required - 310 visits supplied

= 427,921 optometric visit shortage

The shortage of 427,921 optometric visits per year cannot be applied directly to the requirement for optometric manpower, since it represents a composite shortage of vision care manpower which includes the services of both optometrists and ophthalmologists, along with a consideration of the declining productivity of optometrists over the age of sixty-five. However, it is still a very important indicator in the assessment of the need for optometric services.

Conclusion

Through the application of the U.S. Public Health Service criteria, it was concluded that a shortage of optometric manpower in relation to the vision care needs of the population exists throughout the Commonwealth of Puerto Rico. With only forty-nine optometrists in the Commonwealth, the present effective demand of 737,921 optometric visits per year and an optometrist to population ratio of 1.5 per 100,000 attest to a shortage of between 176 and 431 vision care practitioners. The estimated undersupply of optometrists translates into an unmet demand of 427,921 patient visits per year within a population of over three million people. In light of potential differences in the economic demand for vision care services between the Puerto Rican and mainland U.S. populations, the estimates presented in this study should be viewed with some caution. However, until better data become available and the uncertainties resolved, the estimates and projections do provide some basis for comparison and they should be useful to the continued planning and development of optometric resources in Puerto Rico. The projected impact of the Inter American University School of Optometry undoubtedly will necessitate a recomputation of these estimates within the near future. □

"With only forty-nine optometrists in the Commonwealth, the present effective demand of 737,921 optometric vists per year and an optometrist to population ratio of 1.5 per 100,000 attest to a shortage of between 176 and 431 vision care practitioners."

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PART III

Projected Impact of the IAU School of Optometry

The School of Optometry at the Inter American University of Puerto Rico was established in response to a documented unmet need for optometric manpower and vision care services in the Commonwealth of Puerto Rico.[1] As a result of the combined effect of the school's productivity in the generation of new practitioners and in the expanded delivery of optometric services through its clinical facilities, it should have a dramatic impact upon the future availability and distribution of optometric manpower in meeting the demand for optometric services.

The IAU School of Optometry

The Inter American University of Puerto Rico was founded in 1912, and incorporated under the laws of the District of Columbia. Initially affiliated with the United Presbyterian Church, "[i]n 1976 a transfer of corporate registration was made to enable the University, a private institution, to operate more appropriately under the laws of the Commonwealth of Puerto Rico."[2] Even though it is one of the main universities of Puerto Rico, it has served as an educational resource for the entire Caribbean area. In addition to its main campus at San German, it operates a

Metropolitan Campus with academic programs at San Juan, Bayamon, and Buchanan and regional colleges at Aguadilla, Arecibo, Barranquitas, Fajardo, Guayama, Ponce and Ramey. The university system offers a broad selection of courses and academic programs at both the undergraduate and graduate levels, including undergraduate programs in economics and business administration, education and physical education, natural sciences, social sciences and humanities, and graduate programs in the arts, education and business administration. Professional degree programs are offered in nursing, law, and optometry. During the first semester of the 1981-82 academic year, Inter American University had a total enrollment of 34,479 students in its university-wide system.[3]

Inter American University received a provisional license from the Council on Higher Education of Puerto Rico to operate the School of Optometry. As a result of its developmental status, the school has received a provisional accreditation from the Council on Optometric Education of the American Optometric Association and an accrediting certificate from the United States Department of Education. The school, also, has been accepted as a member of the Association of Schools and Colleges of Optometry.

Organization of the School of Optometry began in 1980 with the appointment of an acting dean, and with the following goals and objectives:

A. To develop a program of education in optometry for the production of a specialist capable of fulfilling the responsibilities of a modern optometrist;

B. To contribute to the improvement of visual health in Puerto Rico; and,

C. To ameliorate the extreme shortage of optometrists on the island.

The school offers a four-year professional degree program, leading to the degree of Doctor of Optometry (O.D.). "The projected four-year curriculum is essentially a blend of the curricula of several stateside schools. In its present state of formulation it offers no innovations outside of the fact that the overall program will emphasize bilingual applications and reflect the Hispanic-American culture."[4]

The dean of the School of Optometry reports directly to the president of Inter American University and is a member of the President's Executive Council. The school is organized administratively into two academic departments: the Department of Basic and Visual Sciences and the Department of Clinical Sciences. Each department is headed by a chairman; and, in addition to having primary responsibility for academic and clinical instruction, the chairman of the Department of Clinical Sciences also has authority over the activities of the clinic director and the clinical faculty and staff. The assistant dean, in addition to other duties delegated by the dean, will chair the Admissions Committee, the Academic Review Committee and the Budget and Personnel Committee and will maintain responsibility for the activity of the Student Affairs Committee, the school library and other administrative staff and offices. The administrative organization of the IAU School of Optometry is shown in Figure III-1.

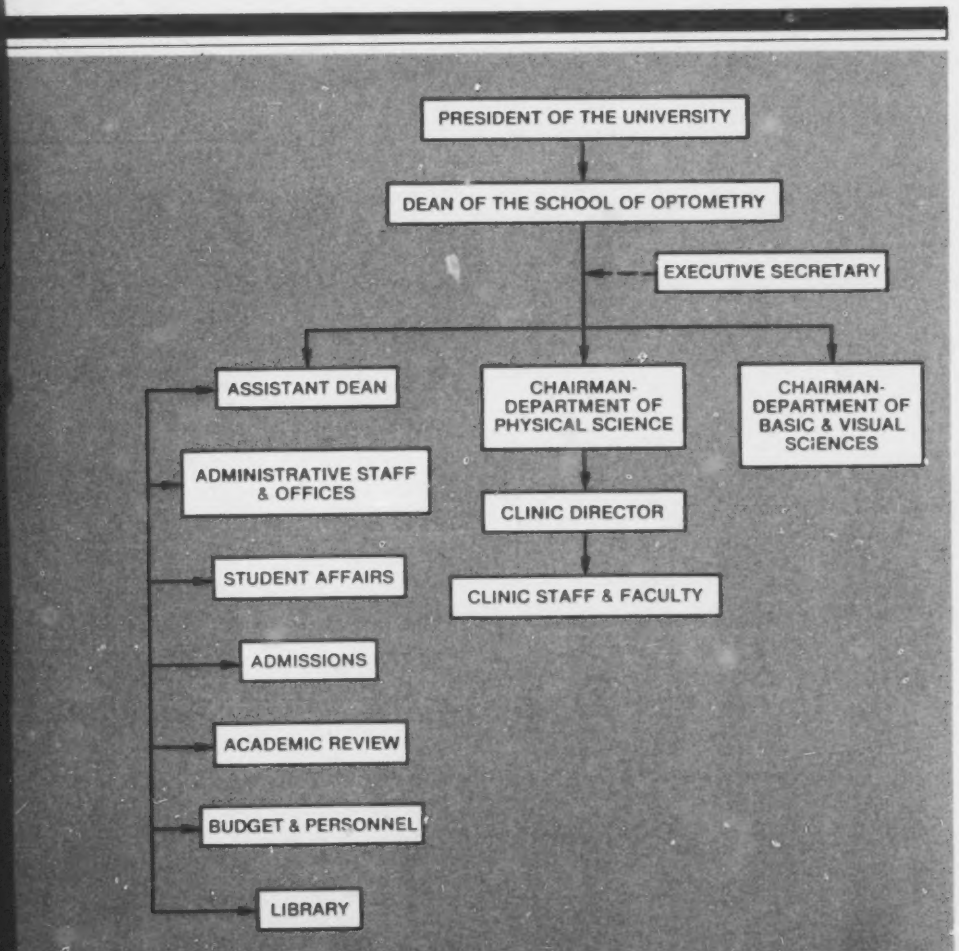


FIGURE III-1
Administrative Organization of the Inter American University School of Optometry, San Juan, Puerto Rico, 1982

During the summer of 1982, the physical facilities of the School of Optometry moved into the newly remodeled five-story Bernardini Building on Eleanor Roosevelt Avenue in Hato Rey (San Juan metropolitan area). In addition to the classrooms, laboratories, library, auditorium, and academic and administrative offices, this building also houses the main teaching clinic of the School of Optometry. The building is designed to accommodate up to thirty-two students per class for each of the four years.

Seventy-three applications for admission (including five from the mainland United States) to the first class to enroll in the School of Optometry were received for the 1980-81 academic year. Of the thirty-two students admitted, twenty-seven enrolled—twenty-six from Puerto Rico and one from the United States.[3] The total applicant pool for the 1981-82 academic year dropped to fifty-eight, but all of the thirty-two students admitted for that year enrolled. All thirty-two were from Puerto Rico. As a result of one transfer into the second-year class from another institution, the size of the student body for the first two classes was sixty.

Projecting the Future Supply, Requirements and Adequacy of Optometric Manpower—Methodology

One of the objectives of the 1982 needs assessment was to project the impact of the IAU School of Optometry upon the future supply and distribution of optometric manpower in Puerto Rico.[5] This impact can be measured in terms of meeting the future requirements and assessing the adequacy of optometric manpower over the next twenty years. As part of the overall planning process, such projections could be used to help maximize the allocation of the school's resources and output to improve the distribution of optometric services throughout the island, and to satisfy any remaining unmet demand within any identifiably needy regional or area population.

Projecting Supply

The projection of the future supply of optometric manpower was considered to be representative of the current supply (O_o) added to the yearly practitioner output (O_i) of the IAU School of Optometry, minus any anticipated losses (L) from the manpower resource pool. Considering only those optometrists who will be professionally active in the rendering of patient care at a given time in the future, the supply at a time in the future was estimated as follows:

$$A_t = a_t c_t S_t$$

where, A_t = the projected number of patient-care optometrists at time t

a_t = the percentage of living optometrists who are professionally active

c_t = the percentage of active optometrists rendering patient care

S_t = the projected number of optometrists alive at time t such that,

$$S_t = O_o + \sum_{i=1}^{t} O_i - L$$

The accuracy of the supply projection is highly contingent upon the certainty of information regarding the productivity of the IAU School of Optometry, including the size of the class, the number of students that graduate, and the number of graduates who remain and practice in Puerto Rico. The information at this time is imperfect due to a lack of historial data. As a resource for the Caribbean and Latin America, the school may eventually have one-half of its entering class coming from outside of Puerto Rico. Therefore, the supply projections have been made under three different assumptions regarding the productivity of the school:

Assumption #1—the school will graduate thirty new practitioners per year, all of which will remain and practice in Puerto Rico;

Assumption #2—the school will graduate fifteen new practitioners per year, all of which will remain and practice in Puerto Rico; or,

Assumption #3—the school will graduate thirty new practitioners per year, fifteen of which will remain and practice in Puerto Rico.

Due to the fact that the school does not have any conclusive control over the determination of the practice location of its graduates and that the new graduates will be free to go into whichever health region they prefer to practice, the projected supply of optometric manpower was limited to aggregate estimates, relating to the total manpower force of the entire island. Where possible, rough estimates regarding the probability of practice distribution were made for the regions.

Projecting Requirements

Projecting the future requirements for optometric services is slightly more risky than projecting the supply of optometrists that will be available in the future to provide services. Requirement projections must consider such variables as: changes in demand, substitutability of services, fluctuations in practitioner productivity, populational shifts, and other factors that have direct influence upon the future requirement for optometric services. In anticipation of these variables and potential changes in the future, several different estimates of consumer demand and practitioner productivity were employed to project a range of possibilities through utilization of the following equation:

$$M_t = (D_t/Q_t)\, N_t$$

where, M_t = the projected optometric requirement at time t

D_t = the projected per capita demand (or need) for optometric services at time t

Q_t = the projected average optometric productivity at time t

N_t = the size of the population to be served at time t

Projecting Adequacy

Projecting and adequacy of optometric manpower in the future, based on the number of optometrists available to provide services but without regard to their distribution of accessibility, was accomplished through a comparison of the projected supply (A_t) with the projected requirements (M_t) at five-year intervals between 1980 and the year 2000. A continuing deficit or a potential surplus of optometric practitioners was projected through the adaptation and application of the following forecasting equation:[6]

$$X_t = a_t c_t S_t - (D_t/Q_t)\, N_t$$

or

$$X_t = A_t - M_t$$

where, X_t = the projected surplus ($X_t > 0$) or deficit ($X_t < 0$)

Through a consideration of the various assumptions and estimates of demand and productivity in the projection of supply and requirements, a range of possibilities regarding the adequacy of optometric manpower was computed for the years 1980 to 2000. An inspection of the regional residence of the matriculants in the first two classes of the IAU School of Optometry provides some information for making inferences about the possible practice location of future graduates, but limitations in regard to the availability of data prohibited any further assessment of adequacy in relation to the future distribution and accessibility of optometric manpower.

Projecting the Future Supply, Requirements and Adequacy of Optometric Manpower—Findings and Discussion

Due to the uncertainties that exist in the immediate future in regard to the productivity or output of the IAU School of Optometry and the number of graduates that will remain in Puerto Rico to practice optometry, the projection of the future supply of optometric manpower (which is highly contingent upon the productivity of the school) is somewhat risky. However, in an attempt to gain some insight into the potential impact of the school upon the manpower situation in Puerto Rico, the following forecasting computations are included:

$$X_t = a_t c_t S_t - (D_t/Q_t)\, N_t$$

Given: $a_t = 1.0$

$c_t = 1.0$

$S_t = 159$, where

$$S_t = O_o + \sum_{i=1}^{t} O_i - L$$

$$= 49 + 120 - 10$$

$$= 159$$

$D_t = 0.2$
$Q_t = 3{,}000$
$N_t = 4{,}100{,}000$
$t = 5$ (i.e., 1987)

Then: $A_t = a_t c_t S_t$
$= 159$
$M_t = (D_t/Q_t)\, N_t$
$= 273$
$X_t = A_t - M_t$
$= -114$

Therefore, employing a very conservative approach in the use of the above statistics, the projection for 1987 indicates the existence of a continuing shortage of at least 114 practitioners. The use of the 0.20 average effective demand rate might not be considered to be very realistic if a more positive approach towards the assessment of "need" is undertaken. To demonstrate the complexity of projecting the future supply of health manpower and the impact of changing one of the variables in the forecasting equation, the five-year (i.e., 1987) projection is recomputed below with a change in the average effective demand rate from 0.20 to 0.30:

$A_t = a_t c_t S_t$
$= 159$
$M_t = (D_t/Q_t)\, N_t$
$= 410$
$X_t = A_t - M_t$
$= -251$

The computation now projects a shortage of 251 practitioners in the year 1987, which reasonably agrees with the projection of the Inter American University study, indicating a shortage of 276 practitioners in 1989, based on an IAU School of Optometry graduation rate of thirty-two students per year.[1]

The productivity of the IAU School of Optometry in relation to its impact upon the future supply of optometric manpower in Puerto Rico has been projected to the year 2000 and is presented in Table III-1. Since the projection is highly dependent upon the number of the IAU optometry graduates that remain in Puerto Rico and become actively engaged in optometric practice, the projection has been calculated to reflect two different rates of graduation and retention of Puerto Rican optometrists (i.e., 30 or 15 per year). At a yearly matriculation and graduation rate of thirty students and practitioners (assuming a zero rate of intra-school attrition), the supply of active optometrists (A_t) in Puerto Rico should increase to 522 by the year 2000. The number of practitioners in the year 2000 will be 267 if the graduation and retention rate averages fifteen per year. The projections of both $A_{t(H)}$ and $A_{t(L)}$—that is, the high and low values for A_t—are dependent, also, upon the expected time of separation, according to age, of the forty-nine optometrists who are presently practicing in Puerto Rico. Table III-2 and Figure III-2 demonstrate the relationship between the estimated requirements for optometric manpower (based upon acceptable provider to population ratios) and the projected supply of optometrists for the years 1980 to 2000. The graduation and retention of thirty new practitioners per year will result in a surplus of optometrists at the requirement ratio of 6.7 per 100,000 by the year 1995, and a surplus at the ratios of 6.7 per 100,000 and 9.3 per 100,000 by the year 2000. In contrast, the graduation and retention of fifteen new optometrists per year will result in the continuation of a deficit of practitioners in all three ratios (i.e., 6.7 per 100,000; 9.3 per 100,000; and 14.3 per 100,000) by the year 2000. The possibility that a surplus of optometrists will exist in Puerto Rico within the next twenty years is, therefore, supportive of the necessity for the school to recruit students from geographical areas outside of the Commonwealth of Puerto Rico, thereby allowing the school to reduce the number of graduates that will practice in Puerto Rico to a level that is appropriate for the effective and efficient delivery of vision care services.

The requirements (M_t) for optometric manpower, relative to the annual per capita demand (D_t) and the annual optometric productivity (Q_t), have been projected for the years 1980 to 2000 and are presented in Table III-3. The projections have been conducted under variable assumptions regarding the level of effective demand and optometric productivity. Five different rates of effective demand have been considered (i.e., 0.20, 0.30, 0.50, 0.67 and 1.00) in calculating the future requirements for optometric manpower. The demand rates of 0.50, 0.67 and 1.00 have been recommended by the American Optometric Association (AOA) as the appropriate intervals between optometric examinations for "problem free" patients; the recommended rates increase with the onset of visual problems and/or complaints.[7] Even though the AOA recommended rates are presented as age-specific rates (i.e., 0.50 for the 25-44 age group; 0.67 for the 17-24 and 45-54 age groups; and 1.00 for the 0-4, 5-16, 55-64, and over 65 age groups), they are used individually for the aggregate population in the estimation of the manpower requirements in Table III-3. Two different productivity rates also have been considered in determining the future requirements. In addition to the figure of 3,000 visits per year per optometrist, as used by the U.S. Public Health Service,[8] a produc-

TABLE III-1

Productivity of the IAU School of Optometry and the Supply of Optometric Manpower, 1980-2000

Year	1980	1981	1982	1983	1984	1985	1986	1987
Supply[1]	49	49	49	49	47	45	42	39
					30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)		30 (15)	30 (15)	30 (15)
		30 (15)	30 (15)	30 (15)	30 (15)		30 (15)	30 (15)
	49		30 (15)	30 (15)	30 (15)	30 (15)		30 (15)
		49		30 (15)	30 (15)	30 (15)	30 (15)	
			49		30 (15)	30 (15)	30 (15)	30 (15)
				49		30 (15)	30 (15)	30 (15)
					77 (62)		30 (15)	30 (15)
						105 (75)		30 (15)
							132 (87)	
								159 (99)

TABLE III-1

Productivity of the IAU School of Optometry and the Supply of Optometric Manpower, 1980-2000

(continued)

Year	1988	1989	1990	1991	1992	1993	1994	1995
Supply[1]	39	39	39	38	35	32	28	24
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
		30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)		30 (15)	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)		30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)		30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)		30 (15)	30 (15)	30 (15)
		30 (15)	30 (15)	30 (15)	30 (15)		30 (15)	30 (15)
	189 (114)		30 (15)	30 (15)	30 (15)	30 (15)		30 (15)
		219 (129)		30 (15)	30 (15)	30 (15)	30 (15)	
			249 (144)		30 (15)	30 (15)	30 (15)	30 (15)
				278 (158)		30 (15)	30 (15)	30 (15)
					305 (170)		30 (15)	30 (15)
						332 (182)		30 (15)
							358 (193)	
								384 (204)

TABLE III-1

Productivity of the IAU School of Optometry and the Supply of Optometric Manpower, 1980-2000

(continued)

Year	1996	1997	1998	1999	2000
Supply[1]	20	15	13	13	12
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)	30 (15)	30 (15)
		30 (15)	30 (15)	30 (15)	30 (15)
	30 (15)		30 (15)	30 (15)	30 (15)
	30 (15)	30 (15)		30 (15)	30 (15)
	30 (15)	30 (15)	30 (15)		30 (15)
		30 (15)	30 (15)	30 (15)	
	410 (215)		30 (15)	30 (15)	30 (15)
		435 (225)		30 (15)	30 (15)
			463 (238)		30 (15)
				493 (253)	
					522 (267)

[1]Assumes a zero rate of intra-school attrition, a 30 or 15 per year rate of graduation for those graduates who become actively engaged in practice in Puerto Rico, and an expected time of separation from the profession for those optometrists already in practice (49) according to their age distribution.

TABLE III-2

The Supply and Requirements for Optometric Manpower by Year, Puerto Rico, 1980-2000

Year	Estimated Population[1]	Numerical Requirements for Optometric Manpower @6.7/100,000	@9.3/100,000	@14.3/100,000	Projected Supply Based Upon the Number of IAU Graduates Per Year[2] @30/Year $A_{t(H)}$	@15/Year $A_{t(L)}$
1980	3,531,100	236.6	328.4	505.0	49	49
1985	3,916,100	262.4	364.2	560.0	105	75
1990	4,263,000	285.6	396.5	609.6	249	144
1995	4,523,700	303.1	420.7	646.9	385	204
2000	4,673,400	313.1	434.6	668.3	522	267

[1]Based upon the estimates of the Puerto Rico Planning Board, Population Projection #75-35, reported in Table II-2 of the Puerto Rico Department of Health State Health Plan, 1980-1985.

[2]Refer to Table III-1.

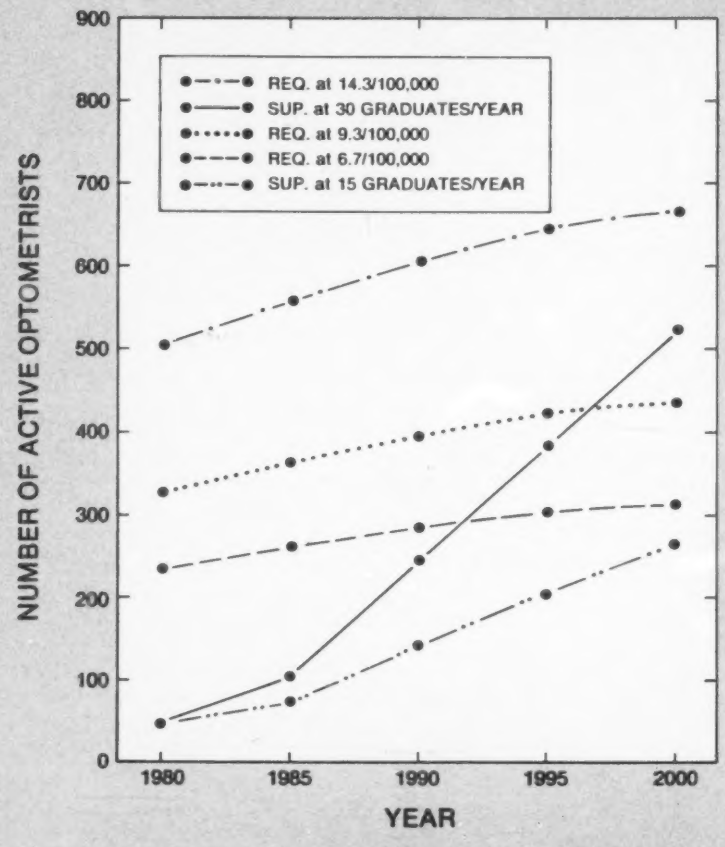


FIGURE III-2
Projections of the Supply and Requirements for Optometric Manpower, Puerto Rico, 1980-2000

tivity figure of 1,500 visits per year has been selected for analysis as a result of similar figures (e.g., 1,350; 1,526; and 1,690) being reported by other studies.[9,10,11]

Using the projected populations (N_t) for each of the five years (i.e., 1980, 1985, 1990, 1995, and 2000) and applying the equation $M_t = (D_t/Q_t)\ N_t$ for all combinations of D_t and Q_t, ten different projections for M_t are presented for each year in Table III-3. For each year, the low and high limits of the predictive range can be determined by the following equations:

$$M_{t(L)} = [D_{t(0.20)}/Q_{t(3,000)}]\ N_t$$
$$M_{t(H)} = [D_{t(1.00)}/Q_{t(1,500)}]\ N_t$$

The low value will be obtained by using the 0.20 demand rate and the 3,000 visit level of optometric productivity; whereas, the high value for the projected requirement of optometric manpower is based upon an annual per capita demand rate of 1.00 and a productivity of 1,500 visits per year.

From the low and high values of the projected supply (A_t) and requirements (M_t), a range of the projected surplus or deficit (X_t) of optometric manpower for a given year can be determined to reflect the changes in the assumptions regarding the supply, utilization and productivity of optometric manpower and the degree of uncertainty that exists in formulating the projections. Table III-4 provides a tabulation of the projected surplus of deficit for each of the five years relative to the high and low predictions for A_t and M_t. The data of Table III-4 are presented graphically in Figure III-3, which demonstrates a broad range of uncertainty about the

TABLE III-3

The Projected Requirements (M_t) by Year for Optometric Manpower Relative to the Annual Per Capita Effective Demand (D_t) and Annual Optometric Productivity (Q_t), Puerto Rico. 1980-2000

1980 (N_t = 3,531,100)

		D_t				
		0.20	0.30	0.50	0.67	1.00
Q_t	1,500	470.7	706.2	1176.9	1577.0	2353.8
	3,000	235.2	353.1	588.3	788.5	1176.9

1985 (N_t = 3,916,100)

		D_t				
		0.20	0.30	0.50	0.67	1.00
Q_t	1,500	522.0	783.2	1305.2	1748.9	2610.5
	3,000	260.8	391.6	652.4	874.5	1305.2

1990 (N_t = 4,263,000)

		D_t				
		0.20	0.30	0.50	0.67	1.00
Q_t	1,500	568.3	852.6	1420.9	1903.9	2841.7
	3,000	283.9	426.3	710.2	951.9	1240.9

1995 (N_t = 4,523,700)

		D_t				
		0.20	0.30	0.50	0.67	1.00
Q_t	1,500	603.0	904.7	1507.8	2020.3	3015.5
	3,000	301.3	452.4	753.7	1010.1	1507.8

2000 (N_t = 4,673,400)

		D_t				
		0.20	0.30	0.50	0.67	1.00
Q_t	1,500	623.0	934.7	1557.6	2087.1	3115.3
	3,000	311.3	467.3	778.6	1043.6	1557.6

NOTE:

$M_t = (D_t/Q_t)\ N_t$

$M_{t(L)} = [D_{t\ (0.20)}/Q_{t\ (3,000)}]\ N_t$

$M_{t(H)} = [D_{t\ (1.00)}/Q_{t\ (1,500)}]\ N_t$

projected status of optometric manpower by the year 2000.

In a brief analysis of the distribution of the students in the first two classes of the IAU School of Optometry, according to their home residence and the delineation of the six health regions, 65.6 percent of the students in the first-year class and 59.3 percent of the second-year class, or 62.7 percent of the total two-year student body, are from the Metropolitan Region; and 15.2 percent of the student body is from the Northeast Region (Table III-5). The West Region is unrepresented in the second-year class, and the East Region is unrepresented in both classes. This type of distribution analysis might provide some insight into the probability of predicting the future practice location of the new IAU optometry graduates. However, no major conclusions in this regard can be formulated at this time.

From the above analysis, it appears that the Commonwealth of Puerto Rico does have, and may have for some time in the future, a shortage of optometric manpower to care for the visual needs of its population. The IAU School of Optometry, therefore, will have a major role to play in the generation of the future manpower supply and in the direct provision of optometric care.

TABLE III-4

The Projected Surplus or Deficit (X_t) of Optometrists by Year and Variation in Assumptions Regarding The Supply (A_t) and Requirements (M_t) for Optometric Manpower, Puerto Rico, 1980-2000

Year	Supply	Requirements $M_{t(L)}$	Requirements $M_{t(H)}$
1980	$A_{t(L)}$	$X_{t(LL)} = -186.2$	$X_{t(LH)} = -2304.8$
	$A_{t(H)}$	$X_{t(HL)} = -186.2$	$X_{t(HH)} = -2304.8$
1985	$A_{t(L)}$	$X_{t(LL)} = -185.8$	$X_{t(LH)} = -2535.5$
	$A_{t(H)}$	$X_{t(HL)} = -155.8$	$X_{t(HH)} = -2505.5$
1990	$A_{t(L)}$	$X_{t(LL)} = -139.9$	$X_{t(LH)} = -2697.7$
	$A_{t(H)}$	$X_{t(HL)} = -34.9$	$X_{t(HH)} = -2592.7$
1995	$A_{t(L)}$	$X_{t(LL)} = -97.3$	$X_{t(LH)} = -2811.5$
	$A_{t(H)}$	$X_{t(HL)} = +82.7$	$X_{t(HH)} = -2631.5$
2000	$A_{t(L)}$	$X_{t(LL)} = -44.3$	$X_{t(LH)} = -2848.3$
	$A_{t(H)}$	$X_{t(HL)} = +210.7$	$X_{t(HH)} = -2593.3$

NOTE: $X_t = A_t - M_t$, where $A_t = a_t c_t S_t$ and $M_t = (D_t/Q_t) N_t$

$A_{t(L)}$ and $A_{t(H)}$ are based upon IAU graduation rates of 15 and 30 Puerto Rican optometrists, respectively (see Table III-1 and Table III-2). $M_{t(L)}$ is based upon an annual effective demand rate (D_t) of 0.20 and an annual optometric productivity (Q_t) of 3,000 visits.

$M_{t(H)}$ is based upon a D_t of 1.00 and a Q_t of 1,500 visits (see Table III-3). Therefore, the values for the projected surplus or deficit (X_t) presented in this table (LL, HL, LH, and HH) represent the extreme limits of the projection spectrum, under the criteria employed in the above equation, such as LL represents the use of the low values for A_t and M_t.

TABLE III-5

Percent Distribution of Regional Residence of the First and Second Year Classes of the IAU School of Optometry by Health Region, 1982

Health Region	First Year Class[1]	Second Year Class[1]	Row Total
Metropolitan	65.6	59.3	62.7
Northeast	15.6	14.8	15.2
North	3.1	11.1	6.8
South	6.3	14.8	10.2
East	0.0	0.0	0.0
West	9.4	0.0	5.1
Column Total	100.0	100.0	100.0

[1]Inter American University, Statistical Report, Fall Semester, 1981-82, December, 1981.

Impressions and Recommendations

The third and fourth years of optometric study are concentrated in the clinical sciences, involving the development and refinement of basic and advanced clinical skills and the delivery of vision care services to the population. To facilitate and effectuate the best possible relationship between the student's learning and the population's receipt of care, it is necessary to rotate the student through several different types of experiential situations involving demands upon different and expanding levels of clinical knowledge and expertise while, at the same time, enhancing the access of different and clinically significant populational groups to the potentiality of receiving such care. Efforts towards the accomplishment of this objective must be mediated through a detailed program of planning and curriculum design.

Therefore, the school has a dual responsibility in regard to the development of its educational and clinical program: to provide a forum for its students to engage in different learning situations; and, to enhance the accessibility of different categorical populations (e.g., the economically and/or medically indigent, the elderly, etc.) to the services that it has to offer.

The planning for and implementation of external, or satellite, clinic programs have become an integral part of the clinical administration of the schools and colleges of optometry in the mainland United States. Satellite clinics offer the student opportunities for learning and community participation that are not readily available at many central facilities. In the development of a regional plan for optometric education

in the western states, the following observations have been made:

> Decentralization of the clinical curriculum during the fourth year appears desirable . . . Each of the schools has already developed some extramural clinical sites . . . These clinical training sites will help encourage optometry students to practice in underserved areas, will improve the quality of vision services available to the public, and will improve the quality of students' educational experiences.[12]

The assumption that external clinic sites will encourage students to practice in underserved areas is supported by the findings of other studies in which the site of the educational and training experience has been shown to have an impact upon the practice location decisions of physicians.[13,14]

To maximize its efforts in fulfilling this responsibility, the school should function within the specified protocol of a carefully designed plan that relates the school's responsibility to its actions. Based upon the results and conclusions presented in this three-part assessment, several goals, objectives and strategies for optometric education in the Commonwealth of Puerto Rico have been recommended:[5]

Goal 1.0.0—To ameliorate the shortage of optometric manpower in the Commonwealth of Puerto Rico.

Objective 1.1.0—To insure that each health region has at least minimal optometric coverage by 1984.

Strategy 1.1.1—Give the highest priority for the location of satellite clinic facilities to the health regions that have no optometrists and/or the greatest degree of unmet need for vision care.

Goal 2.0.0—To facilitate an appropriate distribution and balance of optometric manpower throughout the island.

Objective 2.1.0—To encourage the IAU School of Optometry graduates to seek practice locations in the most underserved areas of the island.

Strategy 2.1.1—Establish at least one externship rotation or residency in each health region, with outreach capability to outlying rural areas.

Strategy 2.1.2—Establish an affiliation with the Puerto Rico Department of Health for the creation of post-graduate residency training positions in the municipal primary care health centers and the regional and/or area hospitals.

Strategy 2.1.3—Establish a preceptor program with practitioners in rural areas to assist in the education of fourth-year student clinicians.

Objective 2.2.0—To increase the applicant pool of students from rural areas and areas with a minimal supply of optometric practitioners.

Strategy 2.2.1—Recruit potential applicants from the patient populations of the satellite facilities.

Strategy 2.2.2—Institute a mentor program involving the student clinicians of the satellite facilities and prospective applicants for admission to the IAU School of Optometry.

Strategy 2.2.3—Utilize adjunct faculty from rural practice locations to serve as role models.

Goal 3.0.0—To expand the educational and experiential base of the student clinicians.

Objective 3.1.0—To increase the exposure and direct involvement of the student clinicians with primary care and community health optometry.

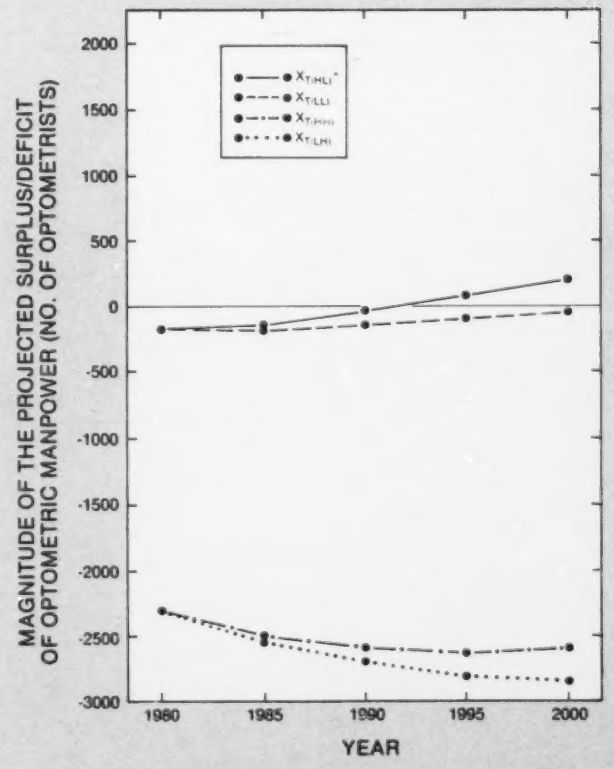
Strategy 3.1.1—Include primary care optometry as a major component within the optometric curriculum, along with a strong didactic and experiential public/community health orientation.

Strategy 3.1.2—Develop primary externships within the primary care health centers of the Puerto Rico Department of Health.

Strategy 3.1.3—Institute a clinical seminar program within the satellite clinics for case discussion and conference.

Strategy 3.1.4—Establish area optometric education centers (AOEC) through the satellite facilities for the continuing education of practicing optometrists and student clinicians.

Added to the above list should be another goal with appropriate objectives and strategies which relate to the need



*$X_{t(HL)}$ represents the use of the high values for A_t and the low values for M_t in the projection of $X_{t(HL)}$.

FIGURE III-3
Projected Surplus/Deficit of Optometric Manpower, Puerto Rico, 1980-2000

of the IAU School of Optometry to develop an effective mechanism for recruiting students from other Latin American and Caribbean countries. This additional goal should address the school's responsibility to (1) expand its scope as an educational resource within the Caribbean and Latin America, and (2) circumvent the potential threat of a surplus of optometric practitioners in Puerto Rico by the year 2000.

Summary and Conclusions—The Need for Optometric Education in Puerto Rico

The IAU School of Optometry (Escuela de Optometria de la Universidad Interamericana de Puerto Rico) is the first and only school of optometry to be established on the Island of Puerto Rico. Prior to its existence, the majority of Puerto Rico's optometric manpower was educated and trained by schools on the United States mainland. An earlier study made by Inter American University, in collaboration with the Colegio de Optometras de Puerto Rico (The Puerto Rican College of Optometrists) and the Association of Schools and Colleges of Optometry, indicated a need for a school of optometry in Puerto Rico as the solution for satisfying the island's requirements for optometric manpower and its demand for vision care services. "The only hope for attaining optometric services that will meet the minimum limits within the next twenty years is to establish a school of optometry in Puerto Rico that will graduate from 24 to 32 optometrists each year."[15]

Based upon the data obtained from the Puerto Rico Department of Health, the Colegio de Optometras de Puerto Rico, and Inter American University, a second assessment of the need for optometric services on the Island of Puerto Rico was undertaken in 1982.[5]

In summarizing the results of the 1982 needs assessment, a shortage of optometric manpower was demonstrated to exist throughout the Island of Puerto Rico. An annual effective demand (i.e., economic demand) for optometric visits for all age groups was estimated to be 737,921 visits per year, requiring an effective supply of 246 optometric practitioners. With only forty-nine optometrists available on the island to serve the visual needs of a total population of approximately 3.3 million people, Puerto Rico's optometric practitioners to population ratio of 1.5 per 100,000 was considered to be unacceptable when compared to the existing and variously recommended U.S. ratios of 6.7, 9.3 and 14.3 per 100,000. The accessibility of optometric care is completely absent in one of the six health regions. Based upon an estimated optometric manpower requirement for the total island of between 225 and 480 practitioners, Puerto Rico presently has a shortage of between 176 and 431 vision care providers, and an optometric visit shortage of 427,921 visits.

Under different assumptions regarding the supply, productivity and utilization of optometric manpower, the projections of the future manpower supply and the per capita requirements to the year 2000 indicate a broad range of possible outcomes relative to the supply/requirement relationship, with the possibilities ranging from a slight surplus to the continuation of a sizeable deficit. The projection of a possible surplus of optometric manpower by the year 2000 should provide the IAU School of Optometry with some degree of concern regarding the planning for future enrollment levels. As the enrollment, graduation, practitioner retention and utilization data stabilize and become more reliable, the level of uncertainty will decrease and the projections of the future supply of and requirements for optometric manpower will become less risky.

The profile of the student body of the IAU School of Optometry was used to provide some indication of the probable practice locations of the school's graduates. This type of consideration should not be overlooked with respect to planning for the future distribution of optometric practitioners and the delivery of services to the total island population. The profile of the first two classes indicates that 62.7 percent of the students come from the San Juan Metropolitan area.

In the design of the clinical program of the IAU School of Optometry, the two primary goals of clinical education and the delivery of services must be integrated into a common strategy for the enhancement of the visual health of the population. The school, through its practitioner productivity and clinical service delivery system, will be the responsible agent in the alleviation of the existing and projected shortage of manpower and in the provision of optometric health care services to the people of Puerto Rico.

Regarding the role and goals of academic optometry, it has been reported in the literature that schools of optometry have obligations which extend beyond the primary functions of educating and training students, including the conduct of clinical research, the expansion of the profession's scientific base, the development of patient care specialties, the development of clinical performance standards, and the dissemination of new clinical information.[16] The Inter American University of Puerto Rico School of Optometry does have the ability to extend itself into these areas through the continued development of its overall clinical and educational program. In time, the IAU School of Optometry should prove to be not only a viable resource of optometric education for Latin America and the Caribbean, but a potential leader in certain aspects of optometric education and of research in the delivery of visual care. □

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Annual Survey of Optometric Educational Institutions 1982-83

The following is a summary of portions of the 1982-83 Annual Survey of Optometric Educational Institutions which is conducted by the American Optometric Association, Council on Optometric Education. The accompanying tables highlight information on student enrollment, academic achievement, financial aid and student expenditures for the year 1982-83. This report is published as an annual feature of JOE.

Student Enrollment

Total student enrollment for the academic year 1982-83 was 4,561. This represented an increase of less than 1% (.44%) over the previous year's enrollment of 4,541. First-year students totaled 1,120.* This represented a decline of 3.6% from the previous year's 1,162.

Female enrollment increased by 8.9% to 1,173 students in 1982-83 from 1,077 in 1981-82, and women represented one-fourth (25.7%) of the total enrollment. The number of women in the 1982-83 entering class comprised 29.3% (328 students) compared to 26.7% or 310 students in 1981-82. This represented an increase of 5.8%.

Minority enrollment accounted for 12.17% (555 students) of the student body in 1982-83 compared to 10.66% in 1981-82. This represented an increase of nearly 15% (14.7%) over the previous year and, for the third year in a row, topped the highest previously-recorded percentage of 8.9% (345 students) of the student body in 1975-76. This year's increase in minority enrollment indicated a continuing climb in the percentage of minority enrolled in the schools and colleges over the past five years. Minority enrollment represented 8.07% of the total student body in 1978-79, 8.78% in 1979-80, 9.52% in 1980-81, 10.66% in 1981-82, and 12.17% in 1982-83.

Women accounted for 37.8% (210 students) of minority enrolled in 1982-83, compared to 34.9% in 1981-82. Of minorities enrolled, 53% were Asian American, 19% Spanish surname, 14% Black American, 11% foreign national, and 3% native American Indian.

Academic Achievement

More than two-thirds of the entering class in 1982-83, 67.4% or 743 students, had four or more years of prior college work before entering optometry school. In addition, the majority of this class, 61.8% or 681 students, had a baccalaureate or higher degree, whereas only 5.6% or 62 students were reported as having 4+ years of prior college work. The number of entering students having four or more years of college represented a decline of 7.8% from the 1981-82 total of 806 (69.7% of the entering class); also, the number of students having a baccalaureate or higher degree decreased by 6.1% from 1981-82's total of 725 students (62.7% of the entering class). It should be noted, however, that the total number of students reported in this table also showed a decrease of 4.8%.

Of the remaining first-year students, 9.5% had 2+ years of prior college work, and 23.1% had 3+ years.

The mean grade point average for entering students in 1982-83 was 3.17, declining from 3.19 in 1981-82. Thirteen of the sixteen U.S. optometric educational institutions had mean grade point averages of 3.0 or better, and six of these institutions had mean grade point averages of 3.25 or better. These grade point averages were based on a total of 1,144 entering students reported in *Information for Applicants to Schools and Colleges of Optometry*, Fall, 1984, published by the American Optometric Association in cooperation with the Association of Schools and Colleges of Optometry.

Financial Aid

The amount of aid granted through institutions other than loans** for the academic year 1982-83 is given in percentages for fifteen of the U.S. institutions. Also, the amount of student loans granted through institutions for 1982-83 is given in the same manner. These show the percentage of students receiving aid in each of the four classes, percentage of average aid, and the percentage from federal and state sources. These amounts previously were reported in dollars on past surveys; therefore, it is impossible to make any comparisons between years or to determine any increases or decreases in amounts, types, or sources of aid for the academic year 1982-83.

Student Expenditures

Annual student expenditures for tuition, fees, books, supplies, and other costs excluding living expenses ranged from $1,975 to $11,425 for residents and $4,369 to $13,425 for non-residents in 1982-83. The mean average expenditure for costs other than room and board was $5,280 for residents and $8,446 for non-residents. These represented increases of 30% and 22% over the 1981-83 mean costs of $4,063 and $6,926 for residents and non-residents, respectively.

The average expenditures for room and board in 1982-83 ranged from $2,192 to $5,571. The mean average expenditure was $3,291. This represented an increase of 11.1% over the previous year's $2,963.

Taken altogether, the mean average cost of education for an optometry student in 1982-83 totaled $8,571 for residents and $11,737 for non-residents. These represented increases of 22% and 18.7%, respectively, over the costs of $7,026 and $9,889 in 1981-82. □

Information for Applicants to Schools and Colleges of Optometry, Fall, 1984. St. Louis, Missouri: American Optometric Association. No explanation can be given for the discrepancy in numbers of first-year students reported in this booklet and the COE Annual Survey of Optometric Educational Institutions.

**Includes scholarships, fellowships, grants in aid, etc.

The following abbreviations have been used in the accompanying tables.

Schools

FSC	—	Ferris State College
IAU	—	InterAmerican University of Puerto Rico
ICO	—	Illinois College of Optometry
IU	—	Indiana University
NECO	—	New England College of Optometry
NSU	—	Northeastern State University
PU	—	Pacific University
PCO	—	Pennsylvania College of Optometry
SCCO	—	Southern California College of Optometry
SCO	—	Southern College of Optometry
SUNY	—	State University of New York
TOSU	—	The Ohio State University
UAB	—	University of Alabama in Birmingham
UCB	—	University of California, Berkeley
UH	—	University of Houston
UMSL	—	University of Missouri-St. Louis

(continued)

Profile of 1982 Entering Class

Grade Point Averages (4.0 Scale)

	High	Low	Mean	Number of Students
FSC	4.00	2.59	3.38	32
IAU	3.58	2.36	2.86	32
ICO	N/A	N/A	2.95	118
IU	N/A	N/A	3.38	67
NECO	3.73	2.44	3.20	84
NESU	4.00	2.64	3.23	25
PCO	3.90	2.50	3.08	137
PU	3.95	2.18	3.16	84
SCCO	3.90	2.80	3.27	97
SCO	3.83	2.10	2.87	112
SUNY	4.00	2.52	3.22	64
TOSU	4.00	2.61	3.33	60
UAB	3.87	2.61	3.30	40
UCB	4.00	2.20	3.32	64
UMSL	3.90	2.10	3.00	30
UH	4.00	2.50	3.16	98
Total				

SOURCE: *Information for Applicants to Schools and Colleges of Optometry, Fall, 1984. St. Louis, Mo: American Optometric Association.*

N/A – Not Available

Provinces and Territories

CZ	— Canal Zone
PR	— Puerto Rico
USP	— U.S. Possessions
ALB	— Alberta
BC	— British Columbia
MAN	— Manitoba
NB	— New Brunswick
NF	— Newfoundland
NS	— Nova Scotia
ONT	— Ontario
PEI	— Prince Edward Island
QUE	— Quebec
SAS	— Saskatchewan
CAN.TER.	— Canadian Territories
O.COUN.	— Other Countries

1982-83 Annual Survey of Optometric Educational Institutions

Number of First Year Students Enrolled with:

	2+ Yrs.	3+ Yrs.	4+ Yrs.	B.A., B.S.	M.A., M.S.	Ph.D.	TOTAL
FSC	20	4	3	2			29
ICO	19	25	18	45	1		108
IU	19	14	3	28	3		67
NECO		9		75		4	88
NSU	8	5	3	9			25
PCO		19		110	7	1	137
PU	5	27	11	38	2		83
SCCO	6	25	13	52	1		97
SCO	16	22	2	69	3		112
SUNY		4	1	57	2		64
TOSU	12	25	4	19			60
UAB		9	1	29	1		40
UCB		30		32	2		64
UH		31		61	6		98102
UMSL		5	3	20	1	1	30
U.S. TOTALS	105	254	62	646	29	6	1102

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Full-Time Students Enrolled in the Professional Degree Program

	First Year		Second Year		Third Year		Fourth Year		TOTALS		
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total
FSC	23	6	24	6	26	4	22	8	95	24	119
ICO	82	26	108	25	127	22	122	25	439	98	537
IU	43	25	39	27	45	23	48	19	175	94	269
NECO	67	21	59	32	55	31	61	20	242	104	346
NSU	19	6	21	3	18	4	16	1	74	14	88
PCO	98	48	104	38	107	38	120	26	429	150	579
PU	66	17	71	12	67	17	65	19	269	65	334
SCCO	66	31	64	31	70	25	66	22	266	109	375
SCO	93	22	109	17	124	18	120	22	446	79	525
SUNY	34	30	36	26	36	26	44	20	150	102	252
TOSU	45	18	44	14	46	14	44	13	179	59	238
UAB	28	14	26	14	24	13	28	7	106	48	154
UCB	38	26	43	23	50	26	43	18	174	93	267
UH	68	30	67	31	67	25	75	26	277	112	389
UMSL	22	8	19	9	26	5	n.a	n.a	67	22	89
U.S. TOTALS	792	328	834	308	888	291	874	246	3388	1173	4561

1982-83 Annual Survey of Optometric Educational Institutions

Minority Group Students Enrolled

	Black American		Spanish Surname		Native American Ind.		Asian Amer.		Foreign Nationals		TOTALS			% of Student
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Total	body
FSC	2								1		3		3	2.52
ICO	1	1	6	2			16	9	3	1	26	13	39	7.26
IU	5	6	8	1	1	1			2		16	8	24	8.92
NECO	4	1	2	4			5	4	4	2	15	11	26	7.51
NSU					6	2					6	2	8	9.09
PCO	5	10	5	3			12	8	3	3	25	24	49	8.46
PU			8		1		35	14	8	3	52	17	69	20.66
SCCO	3	3	8	8	1		47	30	3		62	41	103	27.47
SCO	2	5	7	1	1		10	1	4	1	24	8	32	6.10
SUNY	4	3	1	4			6	5	1	1	12	13	25	9.92
TOSU	2										2		2	0.84
UAB	2	2		2				2			2	6	8	5.19
UCB	3	5	15	4	1	1	41	35			60	45	105	39.33
UH	4	1	14	4	2	1	8	7	10	7	38	20	58	14.91
UMSL	1	1				1	1				2	2	4	4.49
U.S. TOTALS	38	38	74	33	13	6	181	115	41	18	345	210	555	12.17

1982-83 Annual Survey of Optometric Educational Institutions

	Financial Aid Granted Through Institutions Excluding Loans							Student Loans Granted through Institutions					
	Percentage of Students Receiving Aid					From	From	Percentage of Students Receiving Loans					
	1st Year	2nd Year	3rd Year	4th Year	Average	Federal	State	1st Year	2nd Year	3rd Year	4th Year	Average	Federal
FSC	36	29	13	27	26	81	19	36	61	52	37	46	97
ICO	13	21	20	28	21	74	17	88	96	89	85	90	98
IU	16	21	15	4	14	0	2	63	65	72	54	64	95
NECO	42	59	30	40	43	55	34	49	42	30	21	36	100
NSU	50	75	29	n. a	54	76	15	69	83	76	n. a	77	21
PCO	10	5	5	5	6	0	40	80	80	80	80	80	100
PU	7	12	12	9	10	6	94	17	19	19	12	17	95
SCCO	19	33	38	56	37	7	93	90	85	83	89	87	28
SCO								3	30	39	32	26	90
SUNY	55	51	58	36	50	34	52	98	98	98	98	98	97
TOSU	40	35	43	41	40	0	0	32	32	31	30	31	90
UAB	3	3	5	3	4	40	0	78	93	78	73	81	100
UCB	5	6	4	6	5	0	45	32	35	40	20	32	89
UH	19	14	18	3	14	60	0	38	23	37	5	26	30
UMSL								13	13			13	92

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Annual Student Expenditures

	Resident Educational Expenditures					Non-Resident Educational Expenditures					Average Room & Board Expenditures
	1st Year	2nd Year	3rd Year	4th Year	Average	1st Year	2nd Year	3rd Year	4th Year	Average	
FSC	$6,666	$6,116	$6,224	$6,822	$6,457						$2,192
ICO						8,335	8,000	7,530	8,195	8,015	3,150
IU	5,807	9,319	7,963	6,205	7,574	10,216	13,028	11,572	9,312	11,032	2,360
NECO						9,882	9,552	9,640	7,262	9,084	5,571
NSU	2,093	2,148	1,608	n. a	2,039						3,500
PCO	6,445	6,302	5,975	6,035	6,189	9,945	9,702	9,375	9,425	9,611	4,155
PU						9,555	8,255	7,955	7,605	8,343	2,295
SCCO						7,597	7,366	6,493	6,031	6,872	3,700
SCO	7,488	7,193	7,004	3,741	6,351	11,688	11,393	11,204	7,941	10,557	3,906
SUNY	11,700	11,200	10,800	12,000	11,425	13,700	13,200	12,800	14,000	13,425	4,100
TOSU	3,350	3,503	3,401	3,227	3,370	6,780	6,933	6,831	6,657	6,800	2,217
UAB	3,114	3,716	3,151	2,455	3,109	4,374	4,976	4,411	3,715	4,368	3,169
UCB	2,672	1,672	1,885	1,672	1,975	5,882	4,822	5,035	4,822	5,140	3,250
UH	5,153	4,194	4,194	7,360	5,250	6,453	5,394	5,394	7,580	6,205	2,640
UMSL	4,554	4,240	4,240	n. a	4,345	10,554	10,240	10,240	n. a	10,344	3,165

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Permanent Residence

	FSC	ICO	IU	NECO	NSU	PCO	PU	SCCO	SCO	SUNY	TOSU	UAB	UC	U.S. UH	UMSL	Total
AL			1					1	1			97				100
AK							3						1			4
AZ				2		2	9	13	2						1	29
AR			1					1	27					9	1	39
CA		30	5	12		11	43	183	7	1			240	2	6	540
CO		4				14	15	4					3			40
CT		4		42		5			2					1	1	55
DE						7		1								8
DC																0
FL		13	6	9		2	2	8	61				1	28	2	132
GA			1	1		1			41	1		12				57
HI		4		1		2	26	14	1				1			49
ID		3	1				16	8								30
IL		164	10	2		4	3	3	9				1	7	6	209
IN		9	157						2							168
IA		38	7				9	11	2					1	2	67
KS		2	1	1			3	2	12					33	3	57
KY			3					1	32			8		12		56
LA			1						26			3		28		58
ME				24	4								1			29
MD		9	1	4		40			17			6	2	6		85
MA		2	2	120		10			2				1			137
MI	119	68	6			1		1	6					4	3	208
MN		20	7	2			13	11	1		9			1		66
MS									23			4		7		34
MO		2	5				1	4	4					1	54	71
MT				1			15	8					1			25
NE		1	8					1	7		16			16		49
NV						1	5	13	2							21
NH				10			1									11
NJ		5	2	23		76	1	2	4	1			1	2	1	118
NM							4	4	1				3	9		21
NY		43	7	54		44		1	10	246	2		2	7	1	417
NC						38			51			8		7		104
ND		9	1				14	16	1	1	4					46
OH		8	2			4			7		206					227
OK		1	1	1	88		2	2	4					9		107
OR		1					49	4					3			57
PA		18	2	6		265		1	6		1			2	2	303
RI				12				1	2							15
SC			1	1					24			8				33
SD		4	1				11	7	2					1		26
TN		1	1	1		1	2		73							79
TX		4	1				1		4	1				175		186
UT		3		1			11	18	3				1	1		38
VT			1	2					1							4
VA				1		38		1	9			8			1	58
WA		1		1			53	4	3							62
WV		6		3		12			18	1						39
WI		54	23	1		2	8	8	5				2	1	4	108
WY							7	4					1			12
PR			1	5		3			1				1			11
USP																0
ALB							3							1		4
BC		1					2								1	4
MAN																0
NB																0
NF																0
NS																0
ONT		1		2			1									4
PEI																0
QUE										1				2		3
SAS																0
CAN TER																0
O COUN		4	2	2		6	6	3	5				1	14		43
TOTAL	119	537	269	346	88	579	334	375	625	252	238	154	267	389	89	4561